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UNITED STATES DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

WASHINGTON, D. C. 731 MAY 23, 1916

Contribution from the Bureau of Entomology, L. O. Howard, Chief.

THE TRUE ARMY WORM[1] AND ITS CONTROL.

By W. R. WALTON, *Entomological Assistant, Cereal and Forage Insect Investigations.*

INTRODUCTION.

This publication is designed to convey to the farmer, in a brief and simple manner, the natural history of the true army worm, a caterpillar which from time to time becomes enormously destructive to growing cereals, and sometimes to forage crops; to give him a summary of the information necessary for its control; and especially to urge upon him the necessity for constant vigilance in the combat with this insect.

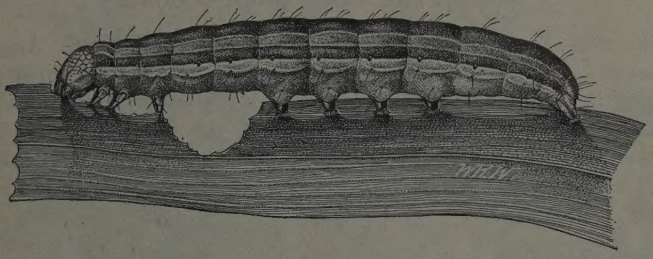

FIG. 1.—The true army worm: Full-grown larva or caterpillar. Enlarged. (Original.)

The true army worm (fig. 1) is often confused in the public mind with the fall army worm,[2] "overflow worm," or "grass worm" as

[1] (*Heliophila*) *Cirphis unipuncta* Haw.; order Lepidoptera, family Noctuidae.

[2] *Laphygma frugiperda* S. & A.

NOTE.—This bulletin is of general interest to crop growers everywhere, and especially east of the Rocky Mountains.

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it is known in some of the extreme Southern States. The latter insect always originates in the South and travels northward as the summer advances. The western army cutworm[1] also is occasionally mistaken for the true army worm, but it occurs in destructive abundance only throughout the regions west of the Mississippi River. Both of the latter insects will be treated in a separate publication.

GENERAL DESCRIPTION.

The fully developed parent of the army worm (figs. 2, *a*, and 5) is a moth or "miller" measuring about 1½ inches across the expanded wings. It is brownish-gray in color, having a single small white spot near the center of the front pair of wings, the hind wings being somewhat darker along the hind edges. Although these parents of the worm sometimes are very numerous, they fly only at night and are therefore often entirely overlooked by the farmer. The stage of the insect most familiar to him is the full-grown, striped, nearly naked caterpillar (figs. 1 and 2, *b*), usually discovered in the act of devouring his crops and in most cases after having already destroyed the greater portion of the infested crop.

WHERE THE ARMY WORM OCCURS.

The true army worm is probably a native of North America, although it is also found in South America. It occurs throughout most of the United States east of the Rocky Mountains, including the States bordering the western banks of the Mississippi and the Missouri Rivers. It also has been found in New Mexico, Arizona, and California. It is not known from the Rocky Mountain Plateau region. (See fig. 3.)

ECONOMIC IMPORTANCE AND MANNER OF INJURY.

The loss in money to the farmer by army worms in the past has been exceedingly great, and although no exact estimate is possible, it is safe to say that in the Eastern States alone many millions of dollars' worth of grain and forage crops have disappeared down their throats during the past 30 years.

[1] (*Chorizagrotis*) *Euxoa auxiliaris* Grote.

FIG. 2.—Stages and work of the true army worm and some of its insect enemies: *a*, Parent or moth; *b*, full-grown larva; *c*, eggs; *d*, pupa in soil; *e*, parasitic fly, *Winthemia quadripustulata*, laying its eggs on an army worm; *f*, a ground beetle, *Calosoma calidum*, preying upon an army worm, and, at right, Calosoma larva emerging from burrow; *g*, a digger wasp, *Sphex* sp., carrying an army worm to its burrow; *h*, *Enicospilus purgatus*, a wasplike parasite of the army worm. All about natural size. (Original.)

The army worm injures crops in but one way, and that is by eating away all the tender portions of the leaves, the immature seed, and sprouts, and when numerous it may even devour the plants down to the very ground. The more important and by far the most conspicuous injury is always inflicted by the nearly full-grown caterpillar, whose greed and capacity for food are almost unbelievable. The pupa takes no food. The moth subsists principally upon the nectar gathered from flowers.

FOOD PLANTS.

The army worm feeds by preference upon grasses, both wild and cultivated; next, upon the grasslike grains, such as the several varie-

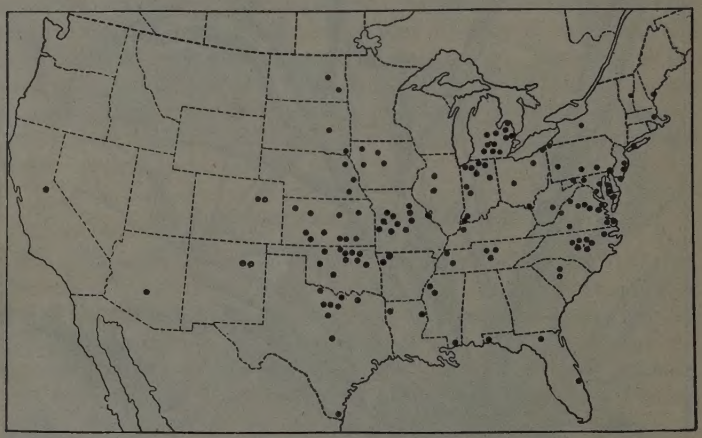

FIG. 3.—Map showing localities in the United States in which the true army worm has been destructive. (Original.)

ties of millet, which suffer severely during outbreaks of the insect. Wheat in its unripe stages, corn, oats, and rye seem to be preferred in the order named. In some portions of the country alfalfa also suffers injury; apparently damage to this crop occurs only in the Southwestern States—Texas, Oklahoma, New Mexico, and Arizona. Occasionally clover is attacked, but such occurrences are rare.

WHERE INVASIONS OF THE ARMY WORM COME FROM.

The true army worm usually appears in the fields very suddenly, and it seems quite certain that the moths at times fly in great numbers for many miles, in the direction of the prevailing winds, and alight in a body to deposit their eggs at some place favorable to the development of their offspring. This fact accounts for the sudden

appearance of the army worm in regions far removed from any known source of infestation. The moth, however, seems to be present in small numbers, over most of the area in which it occurs, during a portion of every year, but this fact does not account for the sudden great invasions which occur from time to time.

WHEN INVASIONS MAY BE EXPECTED.

Generally speaking, outbreaks of the true army worm are more common following cold, backward springs and should be looked for first in neglected portions of fields upon which rank growths of wild grasses or lodged and fallen unripe grain are to be found. These should be examined frequently and closely, especially during late April, May, June, and early July, in order to discover the small greenish caterpillars, which may be found in great numbers feeding near the surface of the ground under the sheltering, overhanging leaf blades.

LIFE HISTORY.

The army worm, like many other common insect pests, has four forms or stages, as follows: First, the parent moths or millers, which seek out rankly growing grass or grasslike grains, such as millet, upon which they lay their eggs (fig. 2, *c*). From these eggs hatch the little caterpillars or "worms," which feed and grow rapidly. When full grown they shed their skins and change to the brown pupa or resting stage, usually beneath the surface of the soil. From these pupæ come the parent moths, which in turn mate and lay their eggs, thus providing for another brood of caterpillars. There are usually three generations of caterpillars in any one year, but seldom or never two successive outbreaks in any given locality.

THE EGG STAGE.

The eggs are laid by the parent moths at night, usually in the folded blades or under the leaf sheaths of grains and grasses (fig. 2, *c*). These resemble small white beads, each considerably smaller than the head of a common pin, and are deposited in masses or rows on the plants selected. Moist or shaded spots usually are chosen for this purpose by the moths, many of which seem to congregate and lay their eggs in the same locality. These eggs hatch in from 8 to 10 days and from them come the very small greenish caterpillars or "worms."

THE CATERPILLAR OR LARVAL STAGE.

When the caterpillars are first hatched they are very tiny and, although countless thousands of them may be present, they consume,

at this time, comparatively little food. Feeding near the ground, sheltered from view by the overhanging grain or grasses, they almost invariably escape the notice of the farmer. If the colony of worms can be discovered at this stage of their growth the infestation usually can be stamped out completely by prompt and vigorous measures, such as spraying with arsenicals or covering with straw and burning over the infested spot.

As the young worms grow and feed, their skins become too small for them, so presently they split and are shed, and the caterpillars begin feeding more greedily than ever. This occurs several times during the life of the caterpillar, until the worm becomes full grown. The time required for full growth is from 3 to 4 weeks. The full-grown army worm (figs. 1 and 2, *b*) is a nearly naked, smooth, striped caterpillar, about 1½ inches long. Its general color is usually greenish, and the stripes, one along each side and a broad one down the center of the back, are dark and often nearly black. The stripe along the back usually has a fine, light-colored, broken stripe running down its center. The color of the body between the dark stripes varies from greenish to reddish brown. The head is greenish brown speckled with black.

When an army of these worms is at work in a field the champing of their jaws is plainly to be heard, as they greedily devour every blade in sight. In this stage the army worm frequently consumes all of the food supply near the place where it has developed from the egg. When such is the case the caterpillars mass together and crawl away in a body in search of other food. It is this habit which has gained for the insect the popular name of "army worm." The massing together of the worms affords the farmer an opportunity of destroying them in great quantities by mechanical methods described on a following page of this publication. When the full-grown caterpillars cease feeding they usually burrow into the soil to the depth of a few inches and by dint of twisting and turning form a cavity or cell therein. The worm then begins to shrink and shorten, after which the skin splits and is shed and the pupa appears beneath it. When the worms are very numerous many of them pupate on the surface of the ground, hidden under clods, boards, or bunches of dried grass and fallen grain.

THE PUPA OR RESTING STAGE.

The pupa (figs. 2, *d*, and 4) or resting stage of the true army worm resembles a date seed in size and shape, but is more pointed at one end. In color it is at first a reddish or chestnut brown, becoming almost black as the time for emergence of the moth approaches. Its

skin or covering is smooth and tough, and the pupa is unable to move any portion of its body excepting its tail, which it wriggles vigorously upon being disturbed. If the soil in which the pupæ are resting be lightly cultivated during this time and the pupæ thrown to the surface, most of them will be killed by exposure to the weather, crushed by the cultivating implements, or eaten during the day by birds or at night by skunks which roam the fields and consume great quantities of such food.

FIG. 4.—The true army worm: Pupa. Enlarged. (Original.)

THE PARENT OR MOTH STAGE.

When the moth (figs. 2, *a* and 5) crawls forth from the pupal case it has not yet developed its wings, which are crumpled and folded in pad-like masses on each side of its back. It usually crawls up the stem of some plant and begins to expand its wings, waving them back and forth slowly for about an hour, by which time they are completely developed and the insect is capable of flying. However, if undisturbed, the moths will usually remain at rest for several hours before flying away to mate and lay their eggs. It takes from 7 to 8 weeks for the insect to develop from the egg to the adult or moth.

After the moths have expanded their wings they do not grow any larger; the small moths are not the young of larger moths, but the

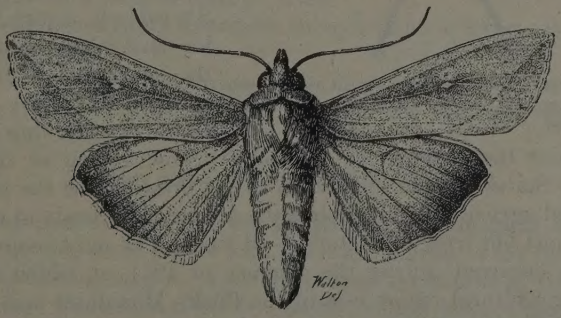

FIG. 5.—The true army worm: Parent or moth. Enlarged. (Original.)

male moth or parent of the army worm is usually considerably smaller than the female.

The army worm moth is strongly attracted to lights at night and frequently swarms of these moths are seen about lights out of doors shortly before an outbreak of the army worm. Farmers would

therefore do well to learn to recognize the moth at sight, as in this way they could be warned of the probable subsequent injurious abundance of the caterpillar. The moths may readily be known by their plain brownish-gray appearance and the presence of a single very small, almost pure white speck or spot near the center of each of the front wings (see figs. 2, *a* and 5). The moths seldom or never lay their eggs near the spot where they have developed and frequently fly for many miles before doing so. Thus there are seldom two successive outbreaks during the year in any given locality. It is not yet definitely known where or how the army worm lives over the winter, but the indications are that it does so in the partially grown caterpillar stage.

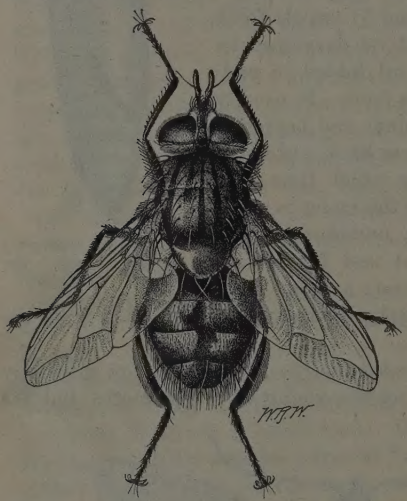

FIG. 6.—*Winthemia quadripustulata*, a fly parasitic on the true army worm: Adult. Much enlarged. (Original.)

HISTORY OF THE ARMY WORM IN THE UNITED STATES.

The army worm has been known as a serious pest on cereal and forage crops in the United States since early colonial times. As early as the year 1632 it is recorded as injuring corn in New England by Peter Kalm, a Swedish naturalist who traveled in this country. In the year 1743 a great outbreak of the army worm is recorded as having occurred throughout that portion of the country now known as the North Atlantic States. From then down to the present time the insect has hampered agriculture and robbed the farmer mercilessly at comparatively short but irregular intervals of time. The most recent serious invasion occurred during the summer of 1914, at which time the entire agricultural region east of the Rocky Mountains and north of the Gulf States suffered to a greater or less degree. From the past history of the insect the farmer may confidently expect to be compelled to cope with it from time to time, and he should ever be on the alert during the spring and early summer months in order to discover the pest before it has made serious inroads upon his crops.

NATURAL ENEMIES.

Most fortunately for the farmer, the army worm has many natural enemies among the native insects, reptiles, birds, and mammals.

INSECT ENEMIES.

One of the commonest and most effective of its insect foes is a medium-sized gray fly[1] (fig. 6), closely resembling, and slightly larger than, the house fly. This parasite sticks its eggs fast to the skin of the caterpillar (fig. 2, *b* and *e*) and the quickly hatching maggots bore through the skin into the flesh, where they soon devour the entire inside portions of the army worm's body. These flies multiply rapidly and often become so numerous as to control the army worm completely in a given locality.

FIG. 7.—Larva of the army worm surrounded by silken cocoons of the wasplike parasite *Apanteles militaris*. About natural size. (Original.)

Another common insect foe is a very small wasplike creature (fig. 7),[2] which pierces the caterpillar with its sting or ovipositor, laying its eggs inside the army worm's body, where they quickly hatch and, the maggots having eaten their fill, bore their way outward and spin little silken cocoons in a mass together, somewhat resembling grains of rice entangled in a mass of cotton. This parasite is also sometimes numerous enough to be of great service in controlling the pest.

Several other insect enemies serve more or less efficiently in combating the army worm. Some of these are shown in figure 2, *f*, *g*, *h*.[3]

WILD BIRDS AND OTHER ENEMIES.

According to the records of the United States Biological Survey, more than 40 species of native wild birds are known to eat the army worm in its various stages. Among the most important of these are the following: Crow blackbird or grackle, yellow-headed blackbird, chipping sparrow, bluebird, prairie hen, and European starling. Domestic fowls of all kinds will greedily devour the caterpillars and pupæ if allowed to roam over infested fields. Skunks and toads also undoubtedly eat thousands of the army worms, both caterpillars and

[1] *Winthemia quadripustulata* Fab.
[2] *Apanteles militaris* Say.
[3] *Calosoma Calidum* Fab., (*Ammophila*) *Sphex* sp., and *Enicospilus purgatus* Say.

pupæ. These birds and other animals should therefore be encouraged and protected by the farmer by all possible means.

CONTROL MEASURES.

WATCHFULNESS AS A FACTOR.

The importance of watchfulness, on the part of the farmer, as a factor in combating the army worm can not be too greatly emphasized. Upon the discovery of the pest in its younger stages depends very largely the possibility of stamping out an infestation before serious injury to crops has occurred. The farmer should examine his meadows frequently during the spring and early summer months, particularly those planted to timothy, bluegrass, and especially millet. He should not be satisfied with looking merely at the surface of the stand; the thicker and longer the growth, the greater the danger from the army worm. The grass or grain should be parted with the hands in various parts of the field and the lower portions of the growth closely examined, in order to discover the presence of the small, greenish caterpillars, and if such be found in any number the area covered by the infestation should be determined and vigorous action taken at once to destroy the worms before they become large enough to begin their journey to other portions of the farm. If the infested spot be small, the grass or grain can be mowed off and straw scattered over the spot and burned, thus destroying the worms. If the caterpillars have become distributed over a considerable area, this can be marked off by stakes and the crop sprayed heavily with a mixture of Paris green at the rate of 1 pound to 50 gallons of water. In case this poison is used, care should be exercised in preventing stock from gaining access to the poisoned grass or grain and being injured or killed by eating it. It is far better to sacrifice a portion of the crop, if the destruction of the pest can be accomplished thereby, because if the army worms are not destroyed they will take the crop anyway and probably devastate other portions of the farm.

POISONED BAITS.

Poisoned baits of varying composition have long been used as a means of destroying the many different species of cutworms and also the army worm. An efficient bait of this kind may be prepared and used as follows: To 50 pounds of wheat bran and 1 pound of Paris green or 2 pounds of arsenate of lead add the juice of one-half dozen oranges or lemons. Then bring the mass to a stiff dough by adding low-grade molasses or sirup, preferably the former, and scatter the mixture broadcast in small pieces throughout the infested field. This poisoned bait may be safely used in alfalfa

and cornfields where it is desired, if possible, to save the crop for forage purposes.

MECHANICAL MEASURES.

In case the worms are not discovered until they have begun to travel in a mass, they can usually be destroyed by furrowing or ditching (fig. 8) completely around the infested area. In attempting to cross such ditches the worms will fall into them and can easily be destroyed by crushing them with a log dragged back and forth through the ditch or furrow. If shallow post holes are sunk in the bottom of the ditch at intervals of about 20 feet, the worms will crawl along the ditch bottoms and fall into the holes, where

FIG. 8.—Ditch prepared to entrap marching army worms. A log, dragged back and forth through the ditch, crushes the worms which have fallen into it. (Original.)

they may be destroyed by crushing or other means. If the subsoil be of such a nature that water penetrates it but slowly, the post holes may be partially filled with water, on the top of which a layer of coal oil or petroleum may be poured. Upon falling into such holes, the worms are almost immediately destroyed without further action on the part of the farmer.

SUMMARY OF CONTROL MEASURES.

(1) Watch fields of growing grass and grain carefully, especially the meadows, during the spring and early summer months, in order

to discover the army worms before they have a chance to become full grown and spread over the entire farm. When the worms are discovered at work do not lose a minute, but attack them vigorously by means of the measures outlined in the foregoing pages.

(2) In case the worms are crawling in a body, surround them with a furrow or ditch and crush them with a log drag as they fall into it.

(3) Poison them by spraying crops not intended for forage purposes with 1 pound of Paris green to 50 gallons of water, or with 2 pounds of arsenate of lead to 50 gallons of water. In case the Paris green is used on tender plants, like corn, 2 pounds of freshly slaked lime should be added to 50 gallons of the mixture. This is to prevent burning the tender plants. Where spraying is not practicable, the use of the poisoned bran bait, mentioned on page 10 of this publication, is strongly recommended.

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FARMERS' BULLETIN

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Contribution from the Bureau of Entomology, L. O. Howard, Chief.

THE CORN AND COTTON WIREWORM[1] IN ITS RELATION TO CEREAL AND FORAGE CROPS, WITH CONTROL MEASURES.

By EDMUND H. GIBSON,
Scientific Assistant, Cereal and Forage Insect Investigations.

INTRODUCTION.

During the three years which have elapsed since the investigation of the corn and cotton wireworm (fig. 1, *b*) was begun there have been constant requests by farmers and others for remedial measures, and it is in answer to these requests that the present paper has been prepared. The injury, as in the case with other wireworms, is caused by the feeding of the worm-like young or larvæ of slender beetles, known as "click beetles" or "snapping beetles," upon the roots, sprouts, and underground stems of plants which are thereby weakened and stunted or killed.

FIG. 1.—The corn and cotton wireworm: *a*, Adult, or beetle; *b*, larva, or wireworm. Much enlarged. (Hyslop.)

EXTENT OF DAMAGE BY THE CORN AND COTTON WIREWORM.

These wireworms have been known totally to destroy corn throughout fields of large acreage. However, this is not usually the case and the attack is most frequently concentrated in "spots" scattered throughout the field, the plants in these spots being wholly destroyed. In other parts of the field there may be slight injury as shown by the dwarfed ap-

[1] *Horistonotus uhleri* Horn; order Coleoptera, family Elateridae.

NOTE.—The object of this bulletin is to set forth in a popular form what is known of the habits of the destructive corn and cotton wireworm, in order that farmers and planters may more effectively carry out control measures and be able better to handle infested areas, that the injury may be reduced to a minimum.

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pearance of the plants, which may later produce 50 per cent or more of a normal yield.

The wireworms are ravenous feeders, often cutting off all the roots of a plant. They are especially destructive during the two months before they transform to adults. A single half-grown wireworm is capable of killing a young corn sprout and severely injuring a plant from 6 to 8 inches in height. Therefore it can be seen that when there is a concentrated attack by many wireworms in one hill the plants have but small chance of surviving.

DESCRIPTION OF THE INSECT IN ITS DIFFERENT STAGES.

The parent of the corn and cotton wireworm (fig. 1, *a*) is a small dark brown click-beetle, or "snapping beetle," measuring about one-fourth of an inch in length. The eggs (fig. 2) laid by this beetle are white and nearly round; when first deposited they are translucent, but in a day or two become opaque. The young wireworms, or larvæ, after hatching from the eggs are minute, measuring from an eighth to three-sixteenths of an inch in length. When from half to full grown (fig. 1, *b*) they may be described as "soft, membranous, and elongate." The body, which is usually white, is apparently composed of 26 segments, or joints, every third segment being swollen. The last segment is simply pointed. The head, which is yellow, is long and slender, and has a pair of prominent, dark brown jaws. When full grown these larvæ measure about an inch in length and are but slightly thicker than pack thread. The pupæ (fig. 3), to which the larvæ change before becoming adult beetles, have the same general color as the larvæ and are about five-sixteenths of an inch long and nearly an eighth of an inch thick. Each pupa occurs in a small earthen chamber constructed by the larva.

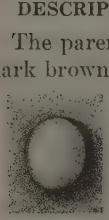

FIG. 2.—Egg of the corn and cotton wireworm. Much enlarged. (Original.)

All stages of the insect are spent in the ground except the adult or beetle, which only enters it at the time of egg deposition.

FIG. 3.—Pupa, or resting stage, of the corn and cotton wireworm. Much enlarged. (Original.)

There are a number of other species of wireworms which are often found associated with this wireworm about the roots of corn and others of its food plants. The corn and cotton wireworm can be easily distinguished from these, however, by its light creamy color and threadlike form, as most other wireworms are stouter and usually either reddish or brownish.

WHERE THE INSECT OCCURS.

Reports show that the corn and cotton wireworm has been destructive in the Carolinas, Illinois, Missouri, Arkansas, and Missis-

sippi. This would indicate a wide distribution, probably a wider one than the mere records reveal, and it is possible that the species may occur throughout the entire eastern half of the United States. Its occurrence is closely related to the distribution of soils of light sandy type, as it is known that the immature stages exist only in such soils. Occasionally an adult has been collected several miles from sandy locations, but its presence there was more than likely due to its own flight from the field of its origin. In some localities this species is referred to as the "sandy-spot wireworm."

PLANTS ATTACKED.

Cotton and corn constitute the principal food plants of this wireworm, and of the cereal and forage crops in the South the greatest damage is done each year to corn. The wireworms, besides feeding upon the roots of corn and cotton, are known to attack oats, rye, cowpeas, crab grass, and Johnson grass. Sweet potatoes, peanuts, tobacco, watermelons, and the roots of a wild bamboo are also among the food plants of this wireworm. The adults have been observed feeding on stems of cowpeas and on young, tender leaves of corn and crab grass.

CHARACTER OF THE INJURY.

Corn plants infested by this wireworm become wilted and stunted, with leaves of a bluish shade, brown at the tips, which stand out from the stalks stiffly instead of bending over gracefully as in a healthy plant. Deprived of most of the roots through the work of the larvæ of this wireworm, the plant can be pulled up with little effort. Weak plants soon succumb, leaving gaps in the rows, but the more vigorous plants put forth new roots in abnormal numbers. These are matted together and distorted, and although the plants survive, only "nubbins" are produced. The infestation is not confined to the impoverished areas, for there may be larvæ among the roots of tall and apparently healthy plants. Rolling land infested by this insect presents a patchy appearance, the sandy knolls standing out distinct and bare, although overgrown later with weeds, particularly crab grass, briers, and morning-glories. For a long time there was a theory among farmers that lightning caused the injury to corn which is now rightly attributed to this wireworm.

In the case of cowpeas, the fibrous roots suffer most, the thicker roots being perforated, so that the plants become yellow and dwarfed, and fail to vine.

Cotton is injured in the early stages by larvæ boring into the seed and injuring the very young plants, checking the growth so much that the plant dies or struggles along only to produce little or no cotton.

LIFE HISTORY OF THE SPECIES.

Beetles of the corn and cotton wireworm (fig. 1, *a*) are abroad in the fields from early June until the last of August. The eggs (fig. 2), which are laid in groups of from 3 to 20 in the soil about the roots of corn, cowpeas, and other food plants, are deposited, for the most part, during late June and July. These hatch in from 8 to 11 days into the young wireworms or larvæ (fig. 1, *b*) which immediately commence feeding upon the roots. The exact duration of the period of development in the soil has not yet been determined, but the information now at hand indicates that the species lives in the larval stage for two years and possibly three. It is true that adults are to be found each year, but this is probably due to overlapping broods. During May or June each full-grown larva constructs a small earthen cell in the soil and in this it changes to a pupa (fig. 3). The pupal stage averages 12 days in length and during this time the pupa is almost motionless and takes no food. After this it transforms to the adult or beetle. As is usually the case, the duration of the egg and pupal stages varies with temperature and moisture conditions.

HABITS OF THE LARVÆ, OR WIREWORMS.

The larvæ, or wireworms, feed upon the roots of their food plants throughout the summer months and up to about the first of October, and during this time are found within 18 inches of the surface of the ground, the depth depending upon the moisture content of the top soil. During a hot, dry spell the wireworms remain from 12 to 18 inches below the surface, but after a rain they can be found within 2 inches of the surface.

With the approach of cold weather they begin a general downward movement, which accounts for the farmer's inability to locate them during the late fall and winter months. At Charleston, Mo., December 1, 1914, they were found in the sand at the remarkable depth of 5 feet. This appeared to be the average depth at which they remained during the winter in this locality, observations showing the depth to vary from 4 to 6 feet. From these facts it will be seen that fall or winter plowing would be useless as a control or remedial measure.

By the last of February in some localities, or as soon as winter breaks up, the larvæ gradually make their way to within 2 to 3 feet of the surface. By the middle of April they are numerous within 6 inches of the surface of the ground. From the time the larvæ travel downward in the fall until they return to the top soil they eat practically nothing. In laboratory experiments, larvæ remained alive and healthy in cages of moist pure sand, without organic food, for six months.

The larvæ are quick of movement and wriggle vigorously when disturbed. In indoor rearing cages they are found to be keenly susceptible to an overabundance of moisture, and, too, will die if the cage soil is allowed to get excessively dry.

Cannibalism is common among them, especially under artificial rearing conditions, but the fact that as many as 106 larvæ have been found in one hill of corn is evidence that this habit does not exist to any great extent in the field when there is plenty of plant food at hand.

HABITS OF THE ADULTS, OR BEETLES.

The adults, or beetles, are also very quick of movement. Immediately upon being disturbed they "snap" themselves and fall to the ground from the leaf or stem upon which they are resting. On the ground they feign death for a few moments, then quickly scamper off to a hiding place. The adults feed very little, hence any injury which they might cause would be hardly perceptible.

They evidently fly well, as they have been collected in quantities around lights at night. This would probably explain the fact that adults have been collected several miles from the nearest sandy spot or field. The author, however, has never seen them fly in the daytime.

The female beetles will not deposit eggs in soil which is crusted over or baked, but leave such a field and search for one which is covered by a dust mulch, or which has recently been plowed. This fact is important and should be taken into account when control measures are being considered, since cultivation at the time the beetles are most numerous means that excellent conditions are given the females for depositing their eggs.

NATURAL ENEMIES.

Comparatively few natural enemies of this wireworm have been noted. No internal parasites have been reared from any stage of the species. Birds feed upon all kinds of wireworms including those of the genus Horistonotus.

INEFFECTUAL REMEDIAL MEASURES.

PLOWING.

Late fall and winter plowing as a method of reducing the numbers of the pest by turning up and exposing the larvæ to the elements is of no value, as the wireworms are at this time at such depths in the soil that they would not be disturbed by the plowing. Plowing or cultivating for this purpose at other times of the year is of little avail as the wireworms are so quick of movement that almost as soon

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